

Description of a new *Homidia* species (Collembola: Entomobryidae) with labial chaetae expanded

Zhixiang PAN^{1, 2①}, Shidi SHI¹

1. School of Life Sciences, Taizhou University, Taizhou, Zhejiang 318000, China

2. School of Life Sciences, Nanjing Normal University, Nanjing, Jiangsu 210093, China

Abstract: *Homidia triangulimacula* sp. nov. is described from Tiantong National Forest Park, Zhejiang Province. It can be easily discriminated from other species of *Homidia* by triangular dark patch on dorsal central mesothorax, labial chaeta M replicated and labial basal and posterior labial chaetae expanded, 6+6 macrochaetae on posterior abdominal segment IV, and middle S-chaeta posterior to macrochaeta m3 on abdominal segment V. A detailed morphological character comparison and a key to species with chaetae expanded on labium or posterior labium in *Homidia* are provided here.

Key words: springtail; *Homidia triangulimacula*; leaflike chaetae; chaetotaxy; taxonomy; key

刺齿蛭属一个下唇刚毛膨大的新种（弹尾纲：长角蛭科）

潘志祥^{1, 2①}, 施时迪¹

1. 台州学院生命科学学院, 浙江 台州 318000; 2. 南京师范大学生命科学学院, 江苏 南京 210093

摘要: 记述采自浙江天童国家森林公园的蛭虫 1 新种：三角斑刺齿蛭 *Homidia triangulimacula* sp. nov.。此新种的鉴定特征为中胸背中间具三角状黑色斑，下唇刚毛 M 双分，下唇基及下唇后侧刚毛膨大，腹部第 IV 节后侧中间具 6+6 根大刚毛，腹部第 V 节中间感觉毛位于大刚毛 m3 的后侧。本文给出了该属下唇或下唇后侧具膨大刚毛物种的形态特征比较和分种检索表。

关键词: 蛭虫；三角斑刺齿蛭；叶状刚毛；毛序；分类；检索表

Introduction

Homidia is a dominant entomobryid genus from China (Pan *et al.* 2015) that can be found in nearly every fieldwork in eastern China and has a body size about 2 mm (based on my samples). Morphological taxonomy is the main tool in the study of this genus. Colour pattern, macrochaetotaxic chaetotaxy of Abd. I and Abd. IV, labial chaetae, the relative position of specialized microchaeta/specialized ordinary chaetae on Abd. I and specialized ordinary chaeta/macrochaeta m3 on Abd. V are the significant diagnostic characters in taxonomy of this genus (Pan & Shi 2012, 2013; Pan *et al.* 2015). Recently, integrative taxonomy (based on both morphological and molecular evidence) was highlighted in Collembola (Katz *et al.* 2015), and was introduced for *Homidia* (Pan *et al.* 2015). It provides a new taxonomic approach for discriminating closely-related species, revealing cryptic species, and supported the validity of the morphological taxonomy in *Homidia*, especially, addressing the significance of colour

Accepted 5 September 2015. Published 25 September 2015. Published online 22 September 2015.

①Corresponding author, E-mail: pzx1118@hotmail.com

pattern (Katz *et al.* 2015; Pan *et al.* 2015).

Expanded labial or posterior labial chaetae are rarely observed in *Homidia*. So far, only five species have been reported: *Homidia apigmenta* Shi *et al.* 2010, *Homidia latifolia* Chen & Li, 1999, *Homidia polyseta* Chen, 1998, *Homidia qimenensis* Yi & Chen, 1999 and *Homidia ziguiensis* Jia *et al.* 2003, all recorded from China. The expanded degrees of those chaetae usually express slight intraspecific variation between individuals (Jia *et al.* 2003). Here, a sixth species with expanded labial and posterior labial chaetae is described.

Tiantong National Forest Park, located in Ningbo City and in the eastern part of Zhejiang Province, belongs to the subtropical monsoon climate. There has been no prior professional investigation into the Collembola from this region. This is the first time describing a new species with labial and posterior labial chaetae expanded. Here, illustrations of the new species and a detailed comparison among closely-related species and a key to those species of *Homidia* are provided.

Material and methods

Specimens were sieved from leaf litter onto a tray or collected using pitfall traps and then selected using an aspirator and stored in 99% ethanol at -20 degree Celsius. Colour patterns were photographed under a Nikon SMZ1000 stereomicroscope mounted with a Nikon DS-Fi1 camera before being cleared. Photographs of parts magnified (more than 100 magnifications) were taken under a Nikon 80i microscope. Multi-layer focused photographs were combined using Helicon Focus 6 (Helicon) and labels were added by Photoshop CS2 (Adobe Inc.). Specimens were cleared in Nesbitt's fluid, mounted under a coverslip in Marc André II solution, and examined using a Nikon 80i microscope with phase contrast. Length was measured employing NIS-Elements Documentation 3.1 software (Nikon). Length data of each trait were measured three times and the mean were accepted. Dorsal cephalic chaetotaxy and basal chaetae of dens are designated following Szeptycki's system (1973), labial palp chaetae are after Fjellberg (1998), labial chaetae are after Gisin (1967), posterior labial chaetae are after Chen & Christiansen (1993), and dorsal tergal chaetotaxy are after Szeptycki (1979).

Abbreviations. Ant. — antennal segment; Th. — thoracic segment; Abd. — abdominal segment; ms — specialized microchaeta(e); sens — specialized ordinary chaeta(e); mac — macrochaeta(e); mes — mesochaeta(e); mic — microchaeta(e); VT — ventral tube; Gr. — group.

All types specimens are deposited in the School of Life Sciences, Taizhou University, Zhejiang, China.

Taxonomy

Key to species with labial or posterior labial chaetae expanded in *Homidia*

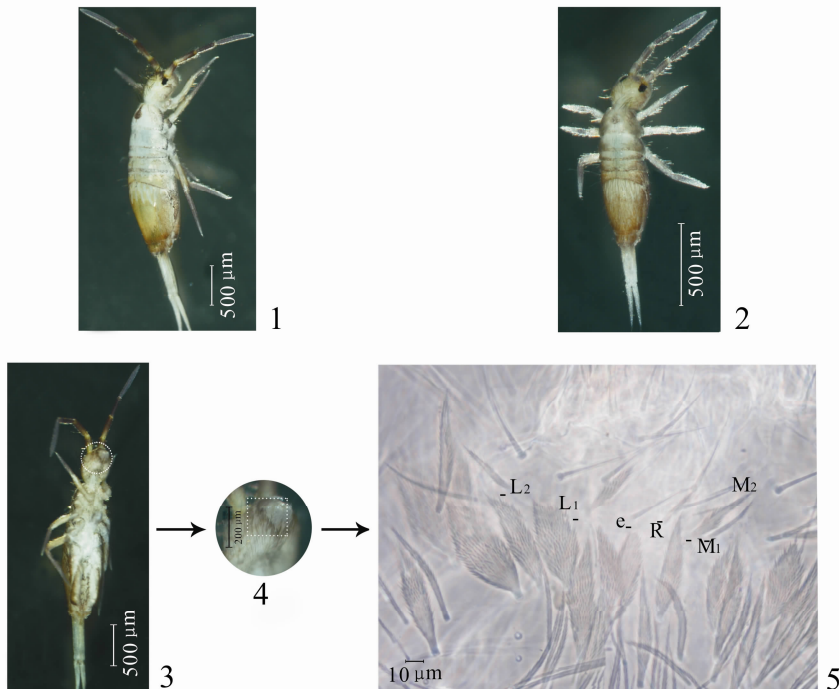
1. Dorsal body without clear pattern *H. apigmenta* Shi *et al.*
- Dorsal body with clear pattern 2
2. Abd. III entirely pigmented, two mac present anterior to "eyebrow" on Abd. IV *H. ziguiensis* Jia *et al.*
- Abd. III partly or without pigment, without mac present anterior to "eyebrow" on Abd. IV 3

3. Central Abd. IV with roughly Y-shaped pigment *H. qimenensis* Yi & Chen
 -. Central Abd. IV without Y-shaped pigment 4
 4. Submental chaeta R replicated, dorsal central Abd. III with 2 dark spots *H. polyseta* Chen
 -. Submental chaeta R not replicated, dorsal central Abd. III with narrow band or without pigment 5
 5. Abd. III with a narrow transverse band and Abd. IV with two transverse bands separated in central part
 *H. latifolia* Chen & Li
 -. Abd. III–IV without transverse band *H. triangulimacula* sp. nov.

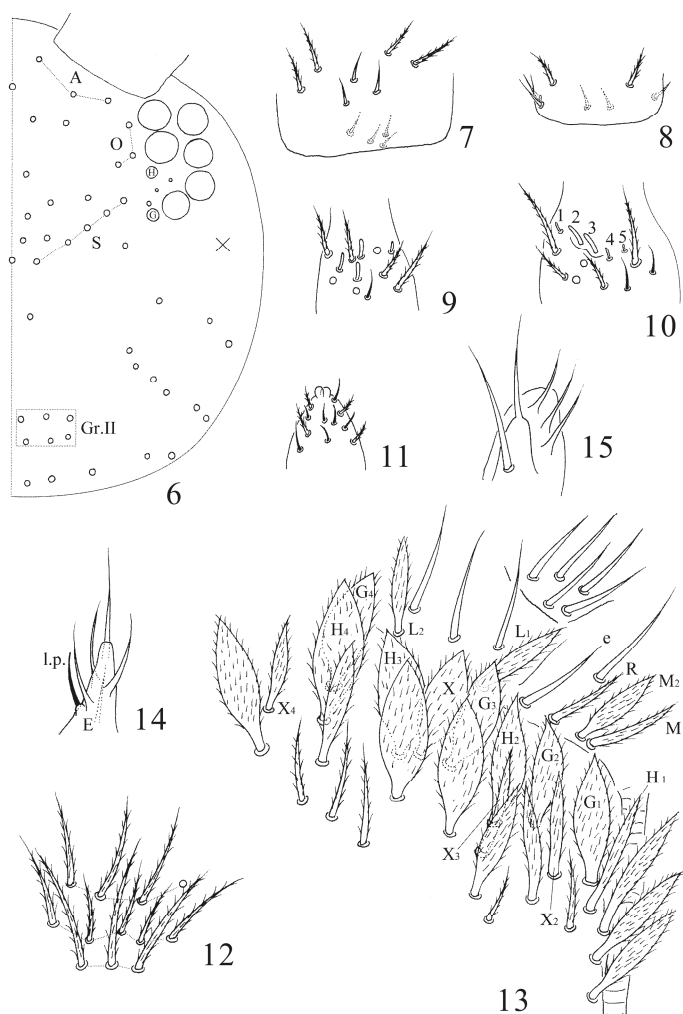
***Homidia triangulimacula* sp. nov.** (Figs. 1–27)

Body length up to 3.88 mm.

Colour pattern. Ground colour pale white in ethanol. Eye patches dark blue, postero-lateral eye patches with black patches of irregular shape, dark band between basal antennae. Distal half Ant. I and Ant II with dark pigment; Ant. III and Ant. IV entirely dark pigmented. Th. II with central triangular dark patch and with narrow strip bidirectionally extended at central axis. Central Th. III with narrow and vary slight stripe. Margin of Th. II–III and lateral and posterior margin of Abd. I–II with light pigment scattered, lateral Abd. III–IV with dark pigment scattered. Coxa and tibiotarsi with dark pigment. Ventral side of body without pigment except distal VT slightly pigmented (Figs. 1, 3). Subadult with similar pattern, but weak (Fig. 2).



Figures 1–5. *H. triangulimacula* sp. nov. 1. Habitus, dorsal view of adult; 2. Habitus, dorsal view of subadult; 3. Habitus, ventral view of adult; 4. Ventral head; 5. Labium and posterior labium.

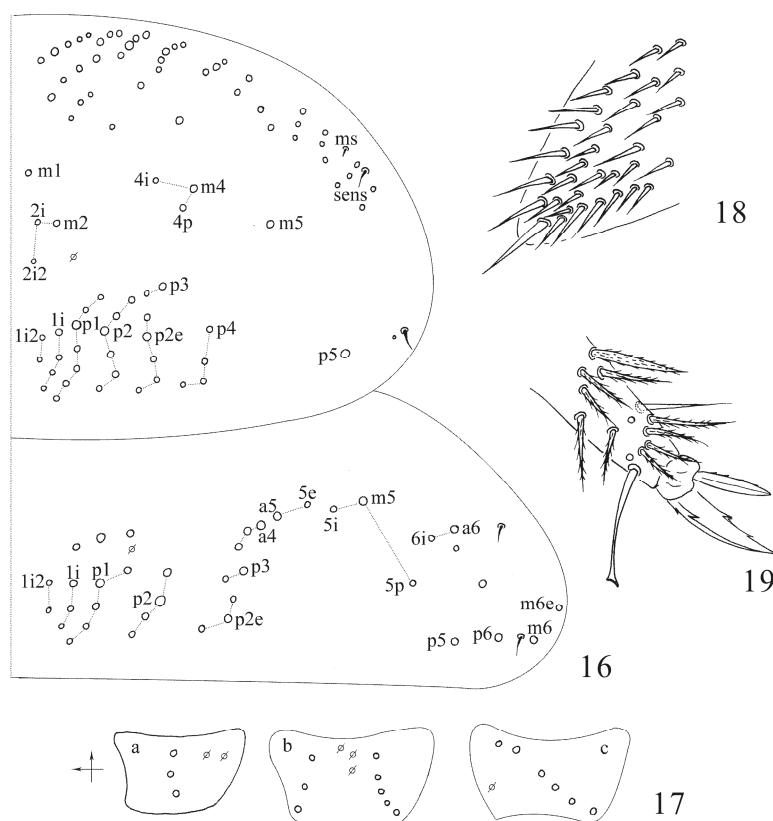


Figures 6–15. *H. triangulimacula* sp. nov. 6. Dorsal cephalic chaetotaxy; 7. Basal Ant. I, dorsal view; 8. Basal Ant. II, dorsal view; 9. Distal Ant. II, ventral view; 10. Ant. III. organ; 11. Ant. IV apical bulb; 12. Clypeal chaetotaxy; 13. Labial and posterior labial chaetotaxy; 14. Papilla E of labial palp; 15. Maxillary outer lobe.

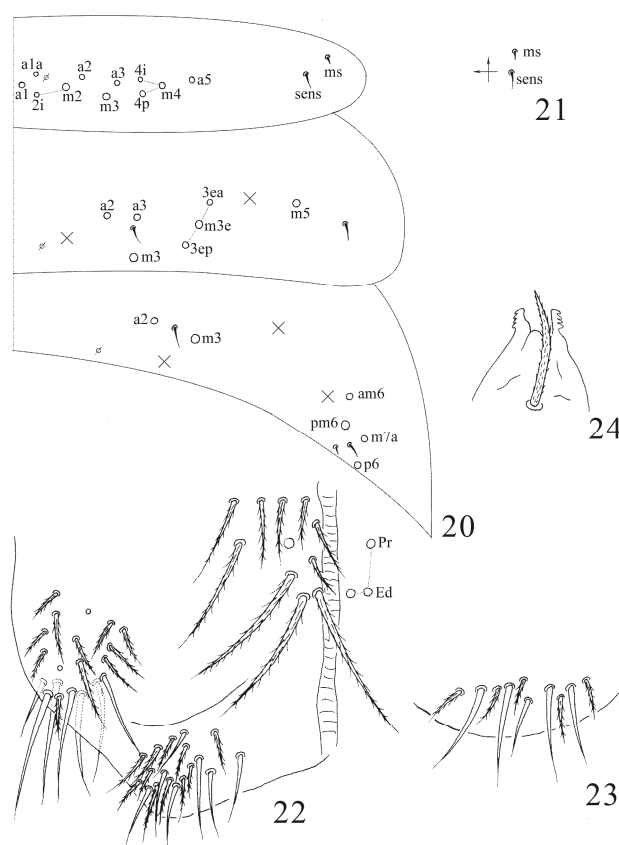
Head. Eyes 8+8, G and H smaller than others and always difficult to observe under light microscope; eye patch with 3 chaetae (Fig. 6). Antennal length 1.68–2.31 times cephalic diagonal in axial direction; antennal segment ratio as I : II : III : IV = 1 : 1.21–1.66 : 1.22–1.46 : 2.23–3.19. Ant. I with 3 dorsal, 4 ventral basal smooth spiny mic (Fig. 7); Ant. II with 5 basal smooth mic (Fig. 8), 2–4 (2–3 longer and 0–1 shorter) distal ventral rod-like S-chaetae (Fig. 9). Ant. III organ with 2 rodlike and 3 short guard S-chaetae (Fig. 10). Apical bulb of Ant. IV bilobed (Fig. 11). Dorsal cephalic chaetotaxy with 3 antennal (A), 3 ocellar (O) and 5 sutural (S) mac; Gr. II with 6 mac (some individuals with 5 on one side) (Fig. 6). Prelabral and labral chaetae as 4/5, 5, 4, all smooth; labral papillae absent, intrusion U-shaped. Clypeus with 12 ciliate chaetae, arranged in 3 lines, 4/5/3 from anterior to posterior,

respectively (Fig. 12). Labial chaetae as $M_1M_2ReL_1L_2$, chaeta e smooth, others ciliate and expanded in different degrees between individuals, the ratio of R/M_2 about 4/5. Posterior labial chaetae G_1 – G_4 , H_1 – H_4 expanded as leaflike, but the expanded degrees vary between individuals, X_{2-4} normal or slightly expanded, X expanded as leaflike (Figs. 4, 5, 13). Five papillae A–E on labial palp with 0, 5, 0, 4, 4 guard chaetae, respectively. Lateral process of labial palp (l.p.) thin with tip not reaching apex of papilla E (Fig. 14). Maxillary outer lobe with 1 apical, 1 subapical chaetae and 3 sublobal hairs on sublobal plate, subapical chaeta subequal to apical one (Fig. 15).

Thorax. Complete body sens as 22/122 (about 57)3, ms as 10/10100. Th. II with 4 ($m1$, $m2$, $m2i$ and $m2i2$) medio-medial, 3 ($m4$, $m4i$ and $m4p$) medio-sublateral and 3 S-chaetae (ms antero-internal to sens); posteriorly with 27–35 mac; $p4$ and $p5$ as mac, $p6$ as mic. Th. III with 36–41 mac and 2 sens; $p5$ and $p6$ as mac, $p4$ as mic (Fig. 16). Coxal macrochaetal formula as 3 (2 pseudopores)/4+1, 3 (3 pseudopores)/4+2 (1 pseudopore) (Fig. 17). Trochanteral organ with 25–35 smooth chaetae (Fig. 18). Tibiotarsus with inner slightly ciliated chaetae. Tenent hair clavate, subequal to inner edge of unguis. Unguis with 3 inner, 2 lateral and 1 outer teeth, lateral two largest. Unguiculus lanceolate with outer edge slightly serrate (Fig. 19).



Figures 16–19. *H. triangulimacula* sp. nov. 16. Dorsal mac chaetotaxy of Th. II–III; 17. Coxal macrochaetal formula (a. Fore leg; b. Mid leg; c. Hind leg); 18. Trochanteral organ; 19. Distal tibiotarsus and claw of hind leg.



Figures 20–24. *H. triangulimacula* sp. nov. 20. Dorsal chaetotaxy of Abd. I–III; 21. Second pattern of ms/sens on lateral Abd. I; 22. VT; 23. Second pattern of smooth chaetal formula on posterior face of VT; 24. Tenaculum.

Abdomen. Abd. IV length 5–7 times Abd. III along dorsal axis. Abd. I with 11 (a1–3, a5, a1a, m2–4, m2i, m4i and m4p) mac and 2 S-chaetae (ms antero-external or anterior to sens) (Figs. 20, 21). Abd. II with 6 (a2, a3, m3, m3e, m3ea and m3ep) central and 1 (m5) lateral mac. Abd. III with 2 (a2 and m3) central and 4 (am6, pm6, p6 and m7a; one specimen with m7a as mic) lateral mac (Fig. 20). One individual with 55 elongate and 2 normal length sens on Abd. IV, and anterior “eyebrow” with sens present. “Eyebrow” with 7–10 mac arranged in irregular transverse row; posterior central with 6 (7) (A4, A6, Ae7, B4–6; Ae7 and B6 smaller than others; A5 only present on one side of 3 individuals). Abd. V with 3 sens, middle one posterior to m3; a1, m3a and p0 as mic (Fig. 25). Anterior face of VT with many ciliate chaetae, among them 3+3 as mac; line connecting proximal (Pr) and external-distal (Ed) mac parallel to median furrow; posterior face of VT with 7 (3+1+3) or 5 (2+1+2) subapical smooth chaetae, middle one shorter (Figs. 22, 23); lateral flap with 6–8 smooth and 9–13 ciliate chaetae on each side (Fig. 22). Tenaculum with 4+4 teeth and 1 large, multi-laterally basal ciliate chaeta (Fig. 24). Manubrial plaque with 3 pseudopores and 6–9 ciliate chaetae on each side (Fig. 26). dens with about 35 spines; basal chaetae (bs1 and bs2) spiny; chaeta pi unclear. Mucro

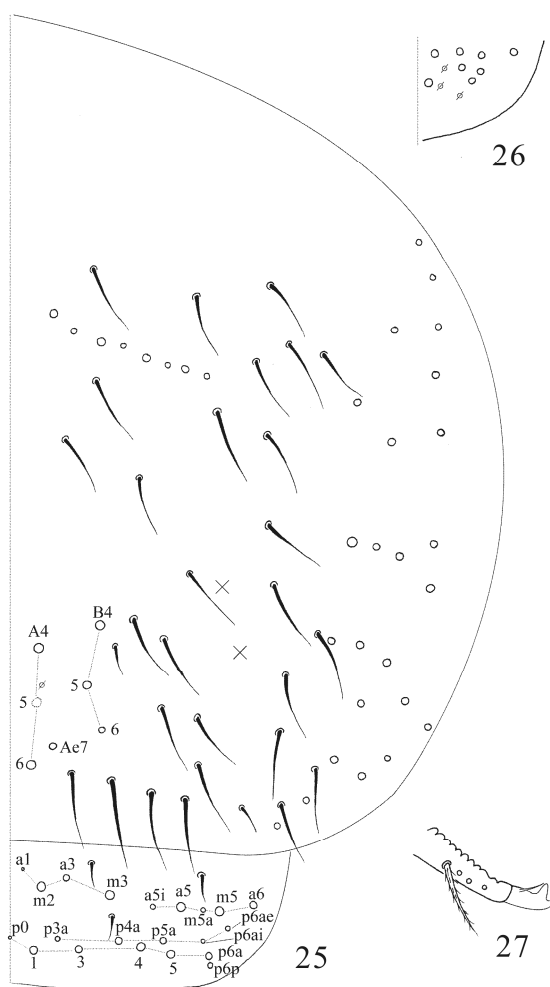
bidentate with subapical tooth larger than apical one; basal spine short, with tip reaching subapical tooth; distal smooth part of denes shorter than mucro in length (Fig. 27).

Ecology. Under the leaf litter of *Schima superba* in forest.

Holotype. ♀ on slide, **China**, Zhejiang, Ningbo City, Yinzhou District, Tiantong National Forest Park, 29°47'37.35"N, 121°47'43.33"E, altitude 103±5 m, sample number 4473, collected by Hui REN, Xin LIU & Sunjie WANG, 18-V-2015. **Paratypes.** 7♀ adult and 1 subadult (instar unclear) on slides and 8 in ethanol, same data as holotype.

Etymology. Named after the triangular dark patch on central Th. II (Latin: triangulum + macula).

Remarks. This new species is characterized by a triangular dark patch on central Th. II, submental chaeta M replicated and labial and posterior labial chaetae expanded, 6+6 mac on posterior central Abd. IV and middle sens posterior to m3 on Abd. V.



Figures 25–27. *H. triangulimacula* sp. nov. 25. Dorsal chaetotaxy of Abd. IV–V; 26. Manubrial plaque; 27. Distal dens and mucro.

H. latifolia is the most similar species to this new species in expanded labial and posterior labial chaetae, M replicated, chaetotaxy of Abd. I–IV. However, it can be easily discriminated by colour pattern and morphology of labial chaetae M_2 , L_1 and L_2 . Also, this new species is similar to four other species with posterior labial chaetae expanded. Detailed differences are listed in Table 1.

Acknowledgements

This study was supported by the Zhejiang Provincial Natural Science Foundation (LQ14C040002, LY15C040001). Thanks are given to our students who collected the specimens for the present study and also given to the anonymous reviewers who provided kind comments on this manuscript.

References

- Chen JX & Christiansen K. 1993. The genus *Sinella* with special reference to *Sinella s.s.* (Collembola: Entomobryidae) of China. *Oriental Insects*, 27: 1–54.
- Chen JX. 1998. A new species of *Homidia* (Collembola: Entomobryidae) from Hunan Province, China. *Entomotaxonomia*, 20(2): 97–99.
- Chen JX & Li LR. 1999. A new species of the genus *Homidia* (Collembola: Entomobryidae) from China. *Acta Entomologica Sinica*, 6(1): 25–28.
- Fjellberg A. 1998. The labial palp in Collembola. *Zoologischer Anzeiger*, 237: 309–330.
- Gisin H. 1967. Espèces nouvelles et lignées évolutives de *Pseudosinella* endogés. *Memórias e Estudos do Museu Zoológico da Universidade de Coimbra*, 301: 5–25.
- Jia SB, Chen JX & Christiansen K. 2003. A new Collembola species of the genus *Homidia* (Collembola: Entomobryidae) from Hubei, China. *Journal of the Kansas Entomological Society*, 76(4): 610–615.
- Katz AD, Giordano R & Soto-Adames FN. 2015. Operational criteria for cryptic species delimitation when evidence is limited, as exemplified by North American *Entomobrya* (Collembola: Entomobryidae). *Zoological Journal of the Linnean Society*, 173(4): 818–840.
- Pan ZX & Shi SD. 2012. Description of a new species in the genus *Homidia* (Collembola: Entomobryidae) from Dalei Mountain, Zhejiang Province. *Entomotaxonomia*, 34(2): 96–102.
- Pan ZX, Zhang F & Li YB. 2015. Two closely related *Homidia* species (Entomobryidae, Collembola) revealed by morphological and molecular evidence. *Zootaxa*, 3918(2): 285–294.
- Shi SD, Pan ZX & Zhang F. 2010. A new species and a new record of the genus *Homidia* Börner, 1906 from East China (Collembola: Entomobryidae). *Zootaxa*, 2351: 29–38.
- Yi YD & Chen JX. 1999. A new species of the genus *Homidia* (Collembola: Entomobryidae) from Anhui Province, China. *Entomotaxonomia*, 21(4): 235–238.
- Szeptycki A. 1973. North Korean Collembola. I. The genus *Homidia* Börner, 1906 (Entomobryidae). *Acta Zoologica Cracoviensis*, 31(2): 23–39.
- Szeptycki A. 1979. *Morpho-systematic studies on Collembola. IV. Chaetotaxy of the Entomobryidae and its Phylogenetical Significance*. Polska Akademia Nauk, Kraków, 219 pp.

Table 1. Detailed differences among *Homidia* species with labial or posterior labial chaetae expanded

characters	<i>H. triangulimacula</i>	<i>H. latifolia</i>	<i>H. apigmenta</i>	<i>H. polyseta</i>	<i>H. qimenensis</i>	<i>H. ziguiensis</i>
	3.9	2.0	3.7	3.4	2.8	3.2
Body length up to (mm)						
Pigment						
Between basal antenna	Band	Spot	Spot	Spot	Band	Band
V-shape on posterior eye patches	-	-	-	-	-	+
Lateral stripes on Th. II	+	+	Slightly	+	-	+
Three spots or stripes on Th. III	-	+	-	+	+	-
Lateral stripes on Abd. I–III	Slightly	-	-	-	-	+
Bands on posterior margin of Abd. II	Slightly	+	-	-	-	-
Pigment on Abd. III	Lateral	Posterior margin band	-	Two spots	central	Entirely
Central Abd. IV	-	Two bands	-	One band	Roughly Y-shaped	Three irregular bands
Labial chaetae						
M ₂ (or Ms)	+	+	Rarely present	+	-	+
Relative length of M ₁ /M ₂ or M/Ms	Equal	Equal	- or >1	1/2	-	5/4
R ₂	-	-	-	+	+	-
Sutural mac	5	5	5	6	5	6
Mac on Abd. I	11	10 (11)	10 (11)	13	11	10–12
Mac on each side of “eyebrow”	7–10	4–7	6–9	22–24	12–13	12–17
Abd. IV (chaetae on posterior central)	6 (7)	4 (5)	4 (5)	25–30	8–9	9–16
A4	Mac	Mac	Mic	Mac	Mac	Mac
A5	Mic (rarely mac)	Mic	Mic	Mac	Mac	Mac

sp. nov.

Table 1. (Continued)

characters	<i>H. triangulumacula</i> sp. nov.	<i>H. latifolia</i>	<i>H. apigmenta</i>	<i>H. polyseta</i>	<i>H. qimenensis</i>	<i>H. ziguiensis</i>
B6	Mas	Mes	Mes	Mac	Mac	Mac
Ae7	Mas	Mic	Mac (rarely mes)	?	Mac	?
Two mac anterior to “eyebrow”	-	-	-	-	-	+
Smooth chaetae on posterior face of VT	5 or 7	8	5–8 (mostly 5)	7	5	5–7
Lateral flap of VT						
smooth chaetae	6–8	7	6–7	8	7	7
ciliate chaetae	8–13	?	13–18	?	11–14	10–14
Locality of holotype	Zhejiang (Ningbo)	Zhejiang (Taizhou)	Fujian (Shaowu)	Hunan (Zhangjiazai)	Anhui (Qimen)	Hubei (Zigui)

Notes: -: absent; +: present; ?: unclear.